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Does gesture add to the comprehensibility of people with aphasia?

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Abstract

Gesture can convey information co-occurring with and in the absence of speech. As such, it seems a useful strategy for people with aphasia (PWA) to compensate for their impaired speech. To find out whether gestures used by PWA add to the comprehensibility of their communication we looked at the information conveyed in gesture (similar to speech, additional to speech or essential information that is absent in speech), produced by 34 PWA and 5 non-brain damaged participants (NBDP) during semi-structured conversation. There were no significant differences found between PWA and NBDP, or between aphasia types. The total number of gestures and the use of similar gestures correlates with the information PWA can convey in speech. Essential gestures are used in instances of speech break down. These findings suggest that gestures used by PWA may add to the compressibility of their communication and that some PWA may use gesture compensatorily.

Index Terms: gesture, speech production, aphasia, compensation

1. Introduction

Gesture can convey information additional to speech or even in the absence of speech [1]. As such, gesture seems a useful compensatory tool for situations in which speech is difficult. For instance, in a bar, where the music is very loud, one could make a drinking gesture to ask whether someone wants a drink. Intuitively this seems a logical strategy. However, people do not easily seem to stop verbal communication and switch to another modality to convey their message [2]. Therefore, in daily life it may be more usual to see people try to shout as loud as possible under these circumstances. Such observations have led researchers to believe that people do not use gesture compensatorily [2] and that the comprehensibility of gesture may be a useful side effect, but not an intended function. For many people with aphasia (PWA), it is no longer possible to convey information in speech. If non-brain damaged people (NBDP) do not use gesture in a compensatory manner does this mean that PWA will not do this either? The present study sets out to find out whether 1) gestures produced by PWA can add to the comprehensibility of their communication and 2) whether, differently from NBDP, PWA use gesture during instances of speech break down.

1.1. Information in speech and gesture

Intentionally or not, gesture can convey information, useful for an interlocutor [3]. This information can be supplementary in that a gestures sometimes conveys information that is not expressed in speech, such as in example 1. Consider a child who tells his mother that he came straight home and accompanies this message with a gesture in which the arms are swinging as if running. The gesture here provides the mother with information additional to the information in speech, namely the manner of the child's return. In some cases, speech may be incomplete and gesture may provide essential information for understanding a message. For instance, as in example 2, when a patient says to the doctor that "he has pain here", while pointing to his leg. Here the gesture is essential for the doctor to understand where the pain is situated.

Example	1	2
"speech"	"I came straight home"	"I have pain here"
gesture	*Arms swing as if running*	*Point to leg*

1.2. Do NBDP compensate using gesture?

Observations such as described above, in which gesture conveys information in addition to that contained in speech, have been used to support the claim that gesture has a communicative function [4].

This communicative function hypothesis is much debated as gesture may also serve other functions, such as aiding cognition [5] or facilitating speech production [6-8]. Following the latter two hypotheses the comprehensibility of gesture may be a useful side effect for an interlocutor, but It may not be its main function. This facilitation hypothesis is supported by evidence showing that people do not deploy gesture in cases of speech difficulties. Gullberg and colleagues showed that gesture production usually stops when speech stops and if gestures are produced during speech break down, these are more often pragmatic (commenting on the fact that there is a speech break down) than representational (depicting the information missing in speech) [2, 9]. They also showed that although representational gestures convey information for an interlocutor, mostly these gestures convey information which is similar to the information conveyed in speech. Therefore representational gestures complement speech but do not replace it [2]. Furthermore, Mayberry and colleagues showed that the production of gesture stops with the production of speech during dysfluent speech in children who stutter [10].

These findings are in line with models that assume that the production of speech and gesture are two highly connected processes [7, 11]. Difficulties in one modality (speech) would be reflected in the other (gesture) restricting the compensatory use of gesture.

1.3. Gesture by PWA

If healthy speakers do not usually compensate for speech difficulties using gestures, can we expect PWA to behave differently? Various studies have shown that PWA use gestures [12, 13] and more importantly that these gestures may benefit their communication [14-17]. Substantial individual differences are reported which, according to Sekine and Rose [12], may be explained by two factors that influence whether PWA use gesture 1) the ability to use gesture and 2) the need to use gesture.

The ability to use gestures: Though research has shown that PWA use gestures, huge individual differences have been reported. The ability to access and select semantic knowledge seems to be an important predictor of PWA's ability to use gesture [14, 17-19]. These findings support the notion that gesture and speech are related processes, but only partly [8]. PWA with difficulties in verbal expression resulting from a semantic impairment, are likely to have difficulties in the production of gesture. PWA with difficulties in verbal expression not resulting from a semantic impairment, for example, a phonological access impairment on the other hand may be able to use gestures still.

The need to use gestures: The studies [2, 9, 10] discussed above claiming that people do not use gesture compensatorily may be explained by the notion that there is no real need for them to put information in gesture. Particularly for second language learners and individuals who stutter the primary goal may be to succeed in putting information in speech despite the struggle to do so. PWA on the other hand, are more often aware of the fact that they will not be able to convey information in speech and instead try other means of communication. Still, there may be differences among different types of aphasia in their need to use gesture [12, 13]. For example, for people with mild or anomic aphasia there may be a need for gesture in cases of word retrieval. A gesture can help replace the missing word ("I would like coffee and ……." + *gesture using an imaginary spoon to scoop something*, in order to communicate the word 'sugar'). For PWA with very limited speech production abilities, the need for gesture may be even larger. Although it might be difficult to convey a full message in gesture, providing some aspect of the message in gesture might increase the likelihood of successful communication of someone otherwise unable to communicate ("……..." + *drinking gesture*, in order to communicate a request for something to drink).

Importantly, gesture may also be comprehensible in cases of unintentional use. Gesture naturally co-occurs with the production of speech and may often convey information [20]. In cases where speech is planned but not produced, gesture might still be produced. This is illustrated by a case-study by Van Nispen and colleagues [21] where an individual with Wernicke's aphasia produced incomprehensible speech, but fairly normal co-speech gestures. Although the individual probably did not intentionally plan to produce the gestures, these gestures still greatly improved his message comprehensibility.

Finally, we wish to point out that the use of gesture may also depend on a third factor; the type of information needed to be conveyed. Gesture seems most useful to convey information regarding actions, movements or shapes [22], but may be more limited for other categories of referents. For instance, one may use gesture to communicate about hobbies (reading a book, cycling, watching television), but it may be more difficult to use gesture to explain your political viewpoint.

1.4. Present study

If healthy speakers do not compensate for speech difficulties using gestures, can we expect PWA to do this? Sekine and colleagues [12, 13] have revealed the type and frequency of gesture used by PWA. Its communicative value remains understudied. Therefore, the present study looks into the communicative value of gestures used by PWA and aims to determine whether these add to the information conveyed in speech. Furthermore, we will look at whether compensatory gestures are used during instances of speech break down.

For this study we examined the gestures used by 34 PWA and 5 NBDP previously analyzed in two earlier studies by Sekine and colleagues [12, 13]. We compared the information conveyed in gesture to the information conveyed in speech by using a coding scheme developed by Colletta and colleagues [23, 24]. The present paper presents preliminary results of this study.

2. Method

2.1. Participants

This study uses data from an online database; AphasiaBank [25], also analyzed in two studies by Sekine and colleagues [12, 13]. The present paper reports on 34 PWA (19 male, age 34-73) and 5 NBDP (1 male, age 36-84). For a detailed description of inclusion and exclusion criteria see [12, 13].

For PWA we examined two variables, both based on the Western Aphasia Battery, WAB [26]:

1) Aphasia type: Broca (n=6), Wernicke (n=8), Anomic (n=8), Transmotor (n=4) and Conduction (n=8);
2) The ability to convey information in speech, based on WAB Spontaneous speech information content.

2.2. Design

Participants were videotaped during a semi-structured interview. An experimenter asked four questions about the participants' recovery and an important event in their lives following a strict protocol (see www.aphasiabank.com):

1) How do you think your speech is these days?
2) Do you remember when you had your stroke?
3) Tell me about your recovery. What kinds of things have you done to try to get better since your stroke?
4) Thinking back, can you tell me a story about something important that happened to you in your life?

Questions for NBDP were comparable. Here the interviewer asked the participant to tell her about an illness or medical condition that they had and whether they had experience with people with language difficulties:

1) Could you tell me what you remember about any illness or injury you've had?
2) Tell me about your recovery from that illness (or injury). What kinds of things did you do to get better?
3) Have you had any experience with people who have a difficult time communicating? Please tell me what the problems were and what you did about it.
4) Thinking back, can you tell me a story about something important that happened to you in your life?

Table 1. Categories for communicative value of gesture related to speech and their definitions with examples.

Category	Gesture label	Definition The information in gesture……(fill in definitions given below) the information in speech	*Example* **"speech"**	 ***gesture***
similar	i Reinforce	is identical to	"me"	*point to self*
	ii Integrate	adds precision to	"drinking"	*pretend to drink*
additional	iii Supplement	adds new information (not essential for understanding the message)	"cake"	*draw round shape*
essential	iv Complement	brings a necessary complement to the incomplete	"I have pain here"	*point to leg*
	v Contradict	contradicts	"Five"	*show four fingers*
	vi Substitute	replaces (missing)	"….."	*thumbs up gesture*
			"slowly"	*move hands upwards*

2.3. Coding

All gestures used by participants were coded for their communicative value. For this we recoded the data from the previous studies by Sekine and colleagues [12, 13], who determined what type of gestures people used. For the present study, we added a second label to every gesture determining its communicative value. For this aim we used a coding scheme developed by Colletta and colleagues [24] which determines the relation of a gesture to the corresponding speech (see Table 1 for short definitions of the labels used). All coding was performed using the software ELAN [27].

2.4. Analyses

For the analyses we collapsed the six gesture labels into three categories; similar, additional, or essential. Similar is defined as information in gesture is similar to that in speech, 2) Additional was categorized if gestures add additional information to information in speech and 3) Essential refers to gestures that are essential for understanding a message (see Table 1). Essential gestures do not necessarily occur in the absence of speech (the gesture: *a hand moving upwards* in combination with the speech "slowly" is essential for understanding the message; there is improvement).

In the analyses we looked at the total number of gestures used, the number of times people used a certain category and the proportion of each category considering the total number of gestures used.

In a quantitative analysis, using ANOVA, we first examined the potential differences in the total use of gestures and gesture categories of communicative value (number and proportions) between PWA and NBDP, and within PWA for aphasia type using Bonferoni's post hoc analysis. Second, we performed correlational analyses for information in speech (WAB spontaneous speech score) and the total number of gestures used and the different gesture categories (number and proportion). Finally, in a qualitative analysis we looked at whether essential gestures occurred during instances of speech break down.

3. Results

3.1. Quantitative analyses

No significant differences were found for the use of similar, additional or essential gestures between NBDP and PWA (see Figure 1), power ranges from .05 to .38 for the dependent variables. Within the group of PWA there were no significant differences for Aphasia Type (see Figure 2), power varies from .11 to .24 for the dependent variables. Information in speech correlated with the total number of gestures r=.36, p=.04 and the number of similar gestures r=.32, p=.06 (trend).

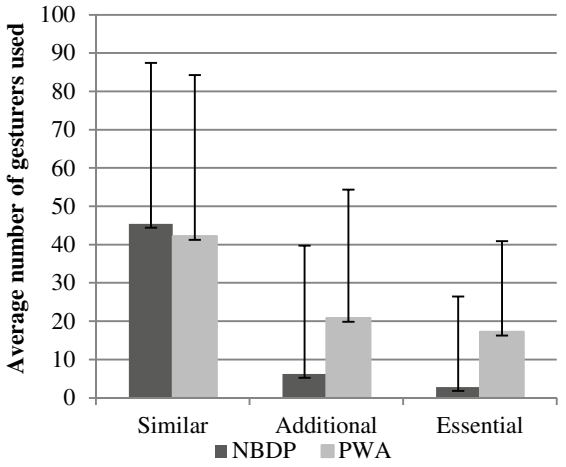

Figure 1. Average numer of gestures used per category; similar, additional and essential for NBDP and PWA (error bars show *SD*).

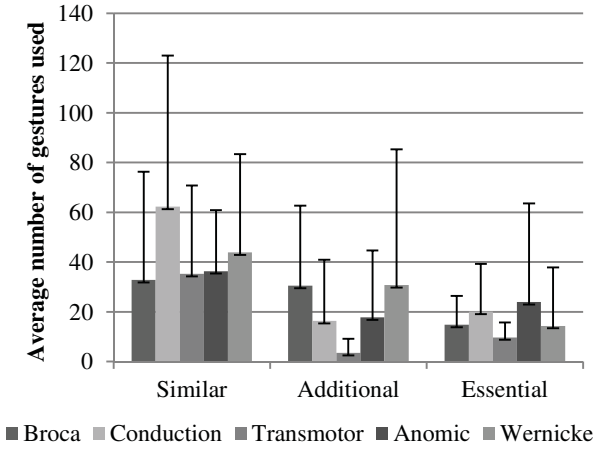

Figure 2. Average numer of gestures used per category; similar, additional and essential by Aphasia type (error bars show *SD*)

3.2. Qualitative analyses

We did not find a difference between NBDP and PWA, or between PWA with different types of aphasia in their use of essential gestures. This does not mean that PWA do not compensate for their speech difficulties in gesture. In this qualitative analysis for two individuals (case ID; Scale 01 and

Kansas 12), we discuss how different essential gestures, occurring with or without speech, compensated for cases of speech break down.

Essential gestures with speech: Both Scale 01 and Kansas 12 use a number of gestures, which are most often produced co-occuring with speech. Their essential gestures also often co-occur with speech (see Figure 4 for an example). The fact that the gesture in this example is used during (semi) fluent speech does not mean that there is no speech break down. The repetition of words ("slowly, slowly"), low speech rate and a short interruption ("uhm") indicate that Scale 01 struggles to find the word ("improving"). The gesture he uses here ensures that this speech break down does not interrupt communication greatly. There are two possible interpretation for the origin of the gesture in this case. Firstly, speech and gesture may have been planned correctly, but the speech was not produced because of difficulties retrieving the correct verb. The gesture may not have been intentionally created for compensation, but is essential under these circumstances nevertheless. A second option is that Scale 01 was aware of the fact that he could not produce the verb "improve" and made this gesture to convey the information instead.

"speech" "Slowly, slowy,uhm,just a tiny bit"
gesture *hand gradually moving upwards*
Figure 4. Example of essential gesture co-occuring with speech. The hands illustrate the concept of 'improvement', not conveyed in speech.

Essential gestures occurring without speech: There are some instances of speech break down where information is conveyed in gesture only. In these situations both individuals tried to compensate using gesture. Kansas 12 experienced a speech break down, thought for a moment ("uhm") and switched to using gesture to convey his message (Figure 5). Scale 01 did something similar (Figure 6). Interestingly, after he performed the gesture, he also conveyed the same information in speech "I can't talk". Maybe the extra time given by performing the gesture helped him in retrieving the information needed to give a verbal response. It may also be that his gesture directly facilitated speech production. Considering this context, Scale's gesture is no longer essential. The intention to make this gesture though seems compensatory.

"speech" "hunting and uh ……."
gesture *swinging the hand as if casting a fishing rod*
Figure 5. Example of essential gesture in absence of speech.

"speech" "Nothing……..I can't talk"
gesture *move lips without sound coming out + moving hand back and forth in front of mouth*
Figure 6. Example of essential gesture in absence of speech.

4. Discussion

4.1. Results

Though PWA seem to use more additional and essential gestures than NBDP, this difference did not reach significance. Neither did we find any significant differences for Aphasia type. Considering the small sample sizes, this might be explained by the low statistical power of our study. We did find correlations between information in speech and the use of similar gestures and the total number of gestures used. Finally, a qualitative analysis showed that PWA use essential gestures during instances of speech break down, which occur both with and without speech.

4.2. Do gestures by PWA add to their communication?

The correlations found between the total number of gestures used and the number of similar gestures used by PWA is in line with the idea that gesture naturally co-occur with the production of speech [20]. Though PWA do not differ from NBDP in their use of additional and essential gestures, these gestures may contribute to the comprehensibility of their communication.

It remains difficult to determine whether gestures are intended compensatorily, or that they are a natural result of planned communication. The observation that essential gestures are used during instances of speech break down suggests that PWA use gesture compensatorily. In this aspect, PWA seem to differ from what NBDP would usually do [2]. Importantly, speech break down often does not result in moments of silence. PWA use various communicative strategies, e.g. speech and gesture, to prevent communication breakdown. These findings support the hypothesis that gestures have a communicative function [4] and can be used compensatorily for information missing in speech [8]

4.3. Future directions

This paper reports on a preliminary results that may contribute to find out whether gestures used by PWA add to the information conveyed in speech and whether gestures are used during instances of speech break down. Our preliminary findings give rise to ideas for future directions.

Firstly, our analyses did not show differences in the use of additional or essential gestures between PWA and NBDP or between different types of aphasia. This suggests a need for both better powered studies and a more detailed analyses in order to determine more precise patient profiles of PWA that do or do not use gestures compensatorily.

Secondly, more analyses are needed to establish whether the coding scheme used is a reliable tool for the analysis of the

communicative value of gestures used by PWA. To this aim we will perform inter- and intra-coder reliability testing.

5. Conclusions

PWA use gestures with and without speech, and these gestures can add to the comprehensibility of their communication. During instances of speech break down, PWA seem to make explicit attempts to convey information, which is missing in speech, by gesture. In this aspect they seem to differ from NBDP. More detailed analyses are needed to determine more precise patient profiles of PWA that do or do not use gestures compensatorily.

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